Appendix A

How X-rays Work
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Electrons exist in a "free" state inside all metals. Free means they are free to move around inside the metal, consuming only a little energy. The little energy required is described by the property of "resistance".

Electrons can be extracted from metals when the temperature of the metal is high enough (a heated Tungsten filament for example), and/or there is a high enough electric field near the surface of the metal to influence the electrons near the surface. Tungsten is used since it resists vaporizing at the highest temperature of any metal.

Electrons not immediately at the surface cannot "see" any electric field, since the surface electrons distribute themselves so as to exactly balance (and cancel) the field: they are "free" to do so, and this is how a Faraday Cage works.

Electrons which have been extracted from any metal surface by a certain Voltage (for example 40,000 Volts or 40 Kilovolts or 40 KV) thereby gain 40,000 Electron-Volts of energy. In common usage, the voltage alone is specified, since almost all devices use electrons.

Such a beam of electrons have almost exactly the same energy. The tiny variation in energy is due to their initial thermal energy variation inside the hot emitter, and this amount is less than one Volt out of 40,000 Volts.

The beam of equally energetic electrons can be deflected from a direct path by any combination of electric and magnetic fields. When applied transverse to the direction of motion, neither electric nor magnetic deflection changes the energy of the electrons in the beam. The deflection is always proportional to the field strength and the time duration of application. So when you control the generation of the deflection field, you control the motion of the electrons in the beam.

As the electrons get really close to the anode (end of the flight path), the information available from any and all physics textbooks runs out. The following is not taught at Stanford or Columbia.

Consider the approach of one electron to a wall of metal atoms (the anode or target). The electron is so small it can really be considered to be a point. But an atom of any metal is completely different. The overall size is one or two Angstroms, and depends upon the identity of the actual material. 10,000 Angstroms is 1 micron (1/1,000,000 of a meter). The spacing of the atoms depends on the material, actually upon the crystal form of the material since metals are usually found in (microscopic) crystal forms.

The relative sizes means "the electron can miss a solid wall of metal". For a while. During the first dozen layers of atoms of target, the electron is just about certain to hit

something. But not absolutely right on the surface. <This is why I referred to 10-1000 LAYERS of atoms in the patent application. More specifically the number 10.>

This relationship is very much like landing a 747 in San Jose. Not at the airport. Landing in downtown. As you let down below the tops of the high-rise banks, you may not immediately hit anything, but when you get to 100 feet from the street, you won't have long to wait.

As the inevitable collision occurs between our single electron and the crystal maze of atoms that it already inside, two different outcomes are distinguished.

1. The electron that was moving hits a glancing blow on one or more of the motionless electrons that are part of one of the target atoms. No particular electron is hit. The moving electron has its energy and direction shifted in some way. Even pre-quantum mechanics requires that a photon (x-ray to us) be emitted to account for this change in momentum. Critical here is that any change of direction is allowed, and any energy loss up to losing it all at once is allowed. So the x-ray emitted can have any energy from zero to max, with the curve of outcomes having a shape which DEPENDS ONLY ON PROBABILITY, and NOT ON THE TARGET MATERIAL. This spectrum of energies is called the CONTINUOUS SPECTRUM, since any energy/frequency/color over a broad range is allowed and is observed.
<All commercial x-rays utilize only the continuous spectrum. This is not the focus of our patent application.>

2. The electron that was moving hits (like a direct hit) a motionless electron that is part of one of the target atoms. The electron that is hit is dislodged from the atom (provided the moving electron had enough initial energy of motion to pay for this). The missing electron-sized-place in the impacted atom is instantly filled by one of the free electrons in the area. When the hole gets filled, a quantum radiation packet which is exactly tied to the energy that was required to knock the motionless electron out MUST be emitted from the atom to balance out quantum mechanics. The energy/wavelength/COLOR of this x-ray is SPECIFIC TO THE TARGET ATOM and which of its many electrons got hit. There are sometimes several possibilities. The name of the set of COLORS of x-rays is called CHARACTERISTIC LINE SPECTRUM. Each COLOR is called a "line" since it looks like that in a spectrum analyzer. All of this is just like in optics, and was familiar to Newton although he couldn't explain it.
<The intentional generation and manipulation of Characteristic Line Spectra is unique to our patent application.>

Now, we are just inside a metal surface and we have just generated either a continuous spectrum or characteristic line spectrum x-ray. Now for a surprise. The metal absorbs the continuous spectrum readily, and does not absorb its own characteristic line spectrum.
<This feature is critical to our patent application>

Appendix A

Whatever the kind of x-ray which has just been generated, its direction is somewhat out of control. Each x-ray has only one direction, but everything is controlled by probability so the effect is a sort of spray in the general direction of the incoming electron.

In our patent, we stress the importance of a thin x-ray conversion (generating) layer. We even suggest how many atomic layers are in it. The x-ray spray generated in the thin layer is three parts: 1. continuing ahead in the conversion layer. 2. escaping from the conversion layer, back into the vacuum. 3. penetrating into whatever is under the effective conversion layer.

Radiation of part 1 will get filtered by the conversion layer, so that none of the continuous spectrum will remain (the conversion layer will not absorb its own characteristic line spectrum but it will absorb the continuous spectrum).
<This is a unique effect that we want to exploit.>

Radiation of part 2 will not get filtered since it escapes quickly into the vacuum. BUT, if we are generating x-rays inside tiny capillaries (our plan), the escaping radiation will quickly cross the vacuum and bury itself in the conversion layer on the other side! And so, it will get filtered on the other side. Everything is radially symmetric, so any x-rays that escape only do so temporarily.

Radiation of part 3 penetrates the conversion layer and encounters (by our design) a heat conducting layer and/or a radiation absorbing layer. Actually, in practical terms, this could easily be the same material. Gold is very heavy. X-ray absorption almost the same as lead (not as cheap however). And it is a fine heat conductor (not as cheap as Copper, but Copper is not particularly absorbing of x-rays unless they are very low energy ones).

You will notice that we have set it up by using:
1. inside of cylinder conversion surfaces
2. layer of conversion material on an x-ray absorber
that we generate x-rays that are almost all
1. characteristic line spectra
2. directed straight ahead (along capillaries).
<These two effects are really unique when combined>